Sacramento Valley Groundwater Basin, Vina Subbasin

- Groundwater Basin Number: 5-21.57
- County: Tehama, Butte
- Surface Area: 125,640 acres (195 square miles)

Basin Boundaries and Hydrology

The Vina Subbasin comprises the portion of the Sacramento Valley groundwater basin bounded on the west by the Sacramento River, on the north by Deer Creek, on the east by the Chico Monocline and on the south by Big Chico Creek. Deer Creek and Big Chico Creek serve as hydrologic boundaries in the near surface. The subbasin is contiguous with the Los Molinos and West Butte subbasins at depth. The Chico Monocline forms a geographic boundary; however, a component of basin recharge is located east of the fault structure. Annual precipitation within the subbasin ranges from 18- to 22.5-inches, increasing to the east.

Hydrogeologic Information

Water-Bearing Formations

The aquifer system is comprised of continental deposits of Tertiary to late Quaternary age. The Quaternary deposits include Holocene stream channel deposits and Pleistocene Modesto Formation deposits, located along most stream and river channels, and alluvial fan deposits. The Tertiary deposits include the Tuscan Formation.

Holocene Stream Channel Deposits. Stream channel deposits consist of unconsolidated gravel, sand, silt and clay derived from the erosion, reworking, and deposition of adjacent Tuscan Formation and Quaternary stream terrace alluvial deposits. The thickness varies from 1- to 80-feet (Helly and Harwood 1985). The unit represents the upper part of the unconfined zone of the aquifer and is moderately-to-highly permeable; however, the thickness and areal extent of the deposits limit the water-bearing capability.

Holocene Basin Deposits. Basin deposits are the result of sediment-laden floodwaters that rose above the natural levees of streams and rivers to spread across low-lying areas. They consist primarily of silts and clays and may be locally interbedded with stream channel deposits along the Sacramento River. Thickness of these deposits can range up to 150 feet and they are observed primarily between Mud Creek and Rock Creek, west of Highway 99. These deposits have low permeability and generally yield low quantities of water to wells. The quality of groundwater produced from the unit is often poor (USBR 1960).

Pleistocene Modesto Formation. The Pleistocene Modesto Formation (deposited between 14,000 to 42,000 years ago) consists of poorly indurated gravel and cobbles with sand, silt, and clay derived from reworking and deposition of the Tuscan Formation and Riverbank Formation. The Modesto Formation makes up the majority of the alluvial plain deposits except where older Riverbank Formation terrace deposits occur south of Pine Creek and the overlying basin deposits in the Nord area predominate. Thickness of the formation can range from less than 10 feet to nearly 200 feet across the valley floor (Helley and Harwood 1985).

Pleistocene Riverbank Formation. The Riverbank Formation (older terrace deposits) consists of poorly-to-highly permeable pebble and small cobble gravels interlensed with reddish clay sands and silt. These deposits underlie the region between Pine Creek and Rock Creek. Thickness of the formation can range from less than 10 feet to nearly 200 feet across the valley floor (Helley and Harwood 1985).

Pliocene Tuscan Formation. The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers. The formation is described as four separate but lithologically similar units, A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units (Helley and Harwood 1985). Units A, B, and C are found within the subbasin and extend in the subsurface west of the Sacramento River.

Unit A is the oldest water bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Unit C consists of massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. In the subsurface, these low permeability lahars form thick, confining layers for groundwater contained in the more permeable sediments of Unit B. Unit C is exposed as alluvial upland deposits west of the Chico Monocline, largely north of Singer Creek. South of Singer Creek, the alluvial upland deposits merge with younger alluvial fan and plain deposits.

The Tuscan Formation reaches a thickness of 1,250 feet over older sedimentary deposits (DWR 2000). The dip of the formation averages approximately 2.5 degrees, east of the valley, and steepens sharply to 10 to 20 degrees southwestward towards the valley at the Chico Monocline. The formation flattens beneath valley sediments.

Recharge Areas

Surface exposure of the Tuscan Formation (Unit B) provides recharge to the subbasin within the subbasin boundaries along stream courses and east of the Chico Monocline fault structure.

Groundwater Level Trends

As part of a groundwater inventory analysis prepared for Butte County, the portion of the Vina Subbasin located within Butte County was evaluated for seasonal and long-term changes in groundwater levels for unconfined and confined aquifer systems. Long-term comparison of spring to spring groundwater levels in the northern part of the Butte County show a decline as a result of the 1976-77 and 1987-94 droughts, followed by a recovery of groundwater levels to pre-drought conditions (DWR 2001).

Evaluation of groundwater level data at the northern edge of the California Water Service area (just north of Chico) shows an average seasonal fluctuation in groundwater levels of approximately 10 feet during years of normal precipitation. Long-term comparison of spring to spring groundwater levels shows a decline in levels associated with the above drought periods with recovery to pre-drought conditions of the early 1970's. Further long-term comparison of spring to spring groundwater levels indicates a 10- to 15-foot decline in groundwater levels since the 1950's (DWR 2001).
Areas unaffected by municipal water use reflect the natural groundwater table distribution and direction of movement. Year-round extraction of groundwater for municipal use in the Chico area causes several small groundwater depressions that tend to alter the natural southwesterly movement of groundwater in the area (DWR 2001). In the Chico area, groundwater levels in the unconfined portion of the aquifer system is about 5- to 7-feet during normal precipitation and up to approximately 16 feet during periods of drought. Annual fluctuation in the confined or semi-confined portion of the aquifer system is approximately 15- to 25-feet during normal years and up to approximately 30 feet during periods of drought. Long-term comparison of spring to spring groundwater levels for confined or semi-confined portions of the aquifer system indicates a 10 to 15-foot decline in groundwater levels since the 1950s.

Groundwater Storage

The storage capacity of the subbasin was estimated based on estimates of specific yield for the Sacramento Valley as developed in DWR (1978). Estimates of specific yield, determined on a regional basis, were used to obtain a weighted specific yield conforming to the subbasin boundary. The estimated specific yield for the Vina Subbasin is 5.9 percent. The estimated storage capacity to a depth of 200 feet is approximately 1,468,239 acre-feet.

Groundwater Budget (Type B)

Estimates of groundwater extraction for the Vina Subbasin are based on surveys conducted by the California Department of Water Resources during the years 1993, 1994, and 1997. Surveys included landuse and sources of water. Estimate of groundwater extraction for agricultural use is estimated to be 130,000 acre-feet. Municipal and industrial use is approximately 20,000 acre-feet. Deep percolation of applied water is estimated to be 30,000 acre-feet.

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types in the subbasin. Total dissolved solids range from 48- to 543-mg/L, averaging 285 mg/L (DWR unpublished data).

Impairments. Impairments include localized high calcium and high nitrates and total dissolved solids in the Chico area.

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	52	0
Radiological	49	0
Nitrates	56	4
Pesticides	49	0
VOCs and SVOCs	48	4
Inorganics – Secondary	52	1

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 50 – 3850	Average: 1212 (22 Well Completion Reports)
	Total depths (ft)	
Domestic	Range: 14 – 754	Average: 139 (2215 Well Completion Reports)
Municipal/Irrigation	Range: 36 –1000	Average: 330 (715 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	23 wells semi-annually
DWR	Miscellaneous water quality	5 wells biennially
Department of Health Services	Miscellaneous water quality	69

Basin Management

Groundwater management:	Butte County adopted a groundwater management ordinance in 1996. Tehama County adopted a groundwater management ordinance in 1994.
Water agencies	
Public	Butte Basin Water User Association, Deer Creek ID, Stanford Vina Ranch ID, City of Chico, Tehama County Flood Control and Conservation District
Private	

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Errata

Changes made to the basin description will be noted here.